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(54) Abstract Title
Multilayer pipe

(57) The pipe 2, for carrying hydrocarbon materials, comprises an inner structural layer 4 formed from a plastics material; a metallic hydrocarbon-resistant barrier layer 8 disposed outwardly of the structural layer 2, the barrier layer 8 being less permeable to the passage therethrough of hydrocarbons than the structural layer 2; and a protective layer 12 disposed outwardly of the barrier layer; characterised in that the outer surface 12 of the pipe is formed from a conductive material. The layer 8 can be of aluminium foil. The outer layer 12 is a conductive polyethylene containing carbon black. The inner structural layer 4, e.g. HDPE, is extruded, the barrier layer 8 is wrapped around it, coated with adhesive on both sides, and the outer layer 12 applied by extrusion coating.

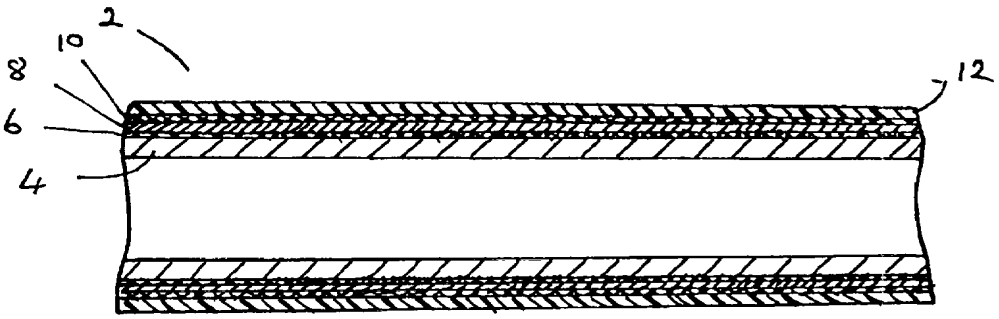

FIG. 1

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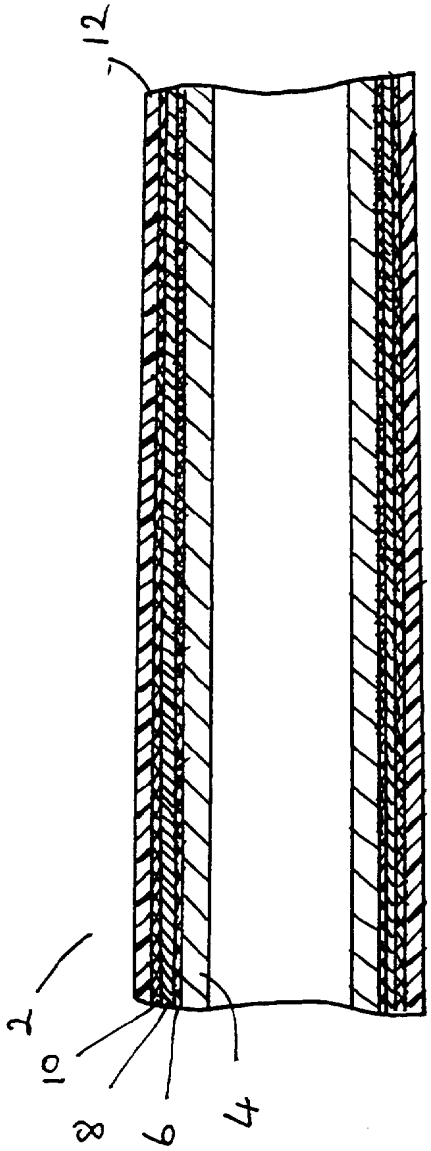

FIG. 1

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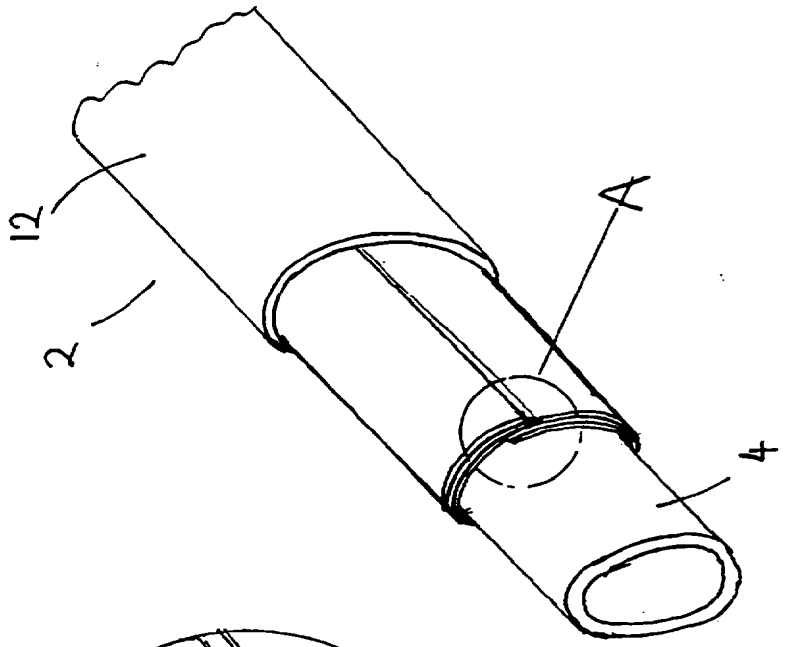

FIG. 2

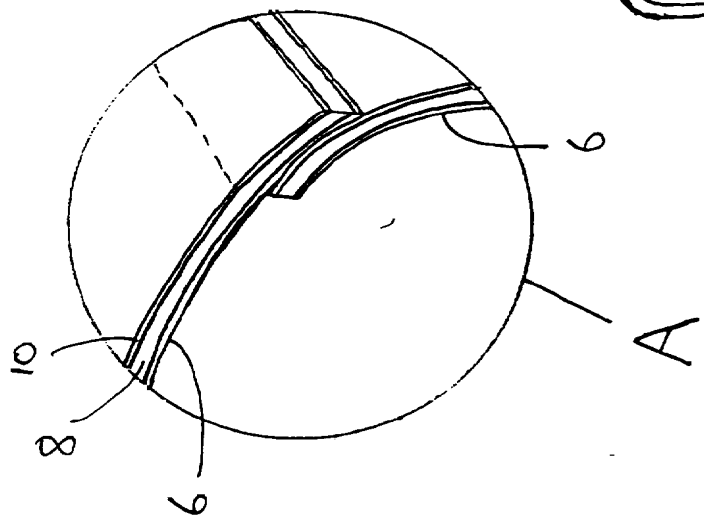

FIG 3

IMPROVEMENTS IN OR RELATING TO PIPES

This invention relates to pipes, and in particular to pipes which are intended to carry hydrocarbons such as petrol.

Petrol supply installations such as petrol stations typically comprise a system of underground storage tanks, dispensing pumps, and supply and vent pipes, as well as other associated petrol forecourt equipment. The pipes or hoses used to connect the various components of such installations are often formed from plastics materials such as polyethylene, a barrier layer formed from a hydrocarbon resistant material such as a metal or a hydrocarbon impermeable polymer being provided to prevent petrol loss through the wall of the pipe.

It is an object of this invention to provide an improved pipe for carrying petrol and other hydrocarbon materials.

Accordingly, the invention provides a multilayer pipe for carrying hydrocarbon materials, the pipe comprising an inner structural layer formed from a plastics material; a metallic hydrocarbon-resistant barrier layer disposed outwardly of the structural layer, the barrier layer being less permeable to the passage therethrough of hydrocarbons than the structural layer; and a protective layer disposed outwardly of the barrier layer; characterised in that the outer surface of the pipe is formed from a conductive material.

The inner structural layer typically is formed from a polyolefin such as polyethylene or polypropylene. The inner structural layer provides the structural strength of the pipe and typically can be from 2.5mm to 15mm thick, more usually from 4mm to 12mm thick. The structural layer provides

containment but is not usually impermeable to hydrocarbons. Hydrocarbon barrier properties are provided by the metallic hydrocarbon-resistant barrier layer which is disposed outwardly of the inner structural layer.

The metallic hydrocarbon-resistant barrier layer is most preferably an aluminium foil layer which can be applied to the inner layer in continuous axial fashion or by winding in a spiral fashion about the inner layer so that there is continuous overlap along the length of the pipe.

The metallic hydrocarbon-resistant barrier layer is preferably adhesively bonded to the inner structural layer and to the protective layer. Suitable adhesives for this purpose are of the heat sensitive type, such as polyethylenes grafted with maleic anhydride or acrylic acid. In order to minimise the electrical insulating properties of the adhesive layer it is typically a relatively thin layer, for example less than 0.5mm thick, more usually less than 0.3mm thick.

The outer surface of the pipe is formed from a conductive material. The conductive outer surface of the pipe can be constituted by the protective layer or by a separate conductive layer coated onto the protective layer. It is preferred however that the protective layer is formed from a plastics material containing a conductive agent, or is formed from a conductive polymer so as to reduce resistance to the flow of charge between the metallic hydrocarbon-resistant barrier layer and the outer surface of the pipe. The protective layer can be formed, for example, from a plastics material containing a conductive agent selected from metal fibres, metal powders and carbon black. In a preferred embodiment, the protective layer is formed from a polyolefin containing carbon black as the conductive agent. The conductivity of the protective layer is chosen such that typically it has a resistance of 10^7 ohms or less and more preferably 10^5 ohms or less. The protective layer is usually up to about 3mm thick, for example from 0.5 to 2mm thick, e.g. approximately 1mm thick.

In a further aspect, the invention provides a method of making a multilayer pipe as hereinbefore defined, the method comprising extruding the inner structural layer, wrapping a metallic hydrocarbon-resistant barrier layer about the extruded inner structural layer and forming the protective layer by extrusion coating onto the barrier layer.

The invention will now be illustrated by reference to one specific embodiment as shown in the drawings of which:-

Figure 1 which is a schematic longitudinal sectional through a pipe according to the invention;

Figure 2 is an isometric view of the pipe of Figure 1 with the various layers revealed; and

Figure 3 is an enlarged view of the region marked A in Figure 2.

As shown in the Figures, the pipe 2 comprises a core layer 4 which is formed from HDPE. In this embodiment, the HDPE is pigmented with an orange-red pigment. Bonded to the core layer 4 by means of an adhesive layer 6 is a layer 8 of aluminium foil which is approximately 300 micron thick in this embodiment, although it can be thicker or thinner than this if required. The aluminium foil 8, pre-coated with adhesive on both sides, is wrapped about the core layer, the edges 8a and 8b (shown as a dotted line) overlapping to ensure that there is an axial overlap along the length of the pipe. The aluminium foil layer acts as a barrier to petrol.

As indicated above, the outer surface of the aluminium is also coated with an adhesive layer 10 which serves to bond the foil to the outer protective layer 12. The outer protective layer 12, which in this embodiment is approximately 1mm thick, is formed from a conductive polyethylene containing carbon black as the conductive substance. The polyethylene

contains sufficient carbon black to reduce the resistivity of the outer layer to less than 10^5 ohm metres. A typical composition for the protective layer is pipe grade polyethylene, e.g. a medium density polyethylene such as MDPE80, containing up to 15% conductive carbon black plus antioxidant additives.

The pipe is formed by extruding, calibrating and partially cooling the core PE layer in conventional fashion. This is followed by application of the aluminium foil (which is precoated with adhesive polymer on both sides) from a coil, using a wrapping machine consisting of a series of rollers and hot air blowers, which progressively apply and heat seal the foil to the core pipe. An overlapping heat sealed joint in the foil wrapping is formed in the axial pipe direction. Once the foil layer 8 has been applied, the outer protective layer 12 is applied by an extrusion coating method to the hot foil layer and adhesive. Thus, an annular die is employed to apply the extruded coating to the foil wrapped core pipe, a vacuum being applied under the annular extruded melt so that the coating layer 12 is drawn down onto the aluminium surface, giving a snug fit and adhesion to the exterior of the foil wrapped core. Following extrusion coating, the pipe 2 is spray cooled, marked and cut in conventional fashion.

The structure of the pipe 2 is such that any electrical energy, static or otherwise, within the aluminium layer is dissipated outwardly into the conductive outer layer 12 and thence into the surrounding earth. Although the adhesive layer 10 does have some insulating properties and hence does provide some resistance to the flow of electricity from the aluminium layer to the outer conductive layer, the overall resistance of the adhesive layer is low and it has a negligible effect on the earthing process. This is because the area of contact between the layers is very large (area for a 63mm OD pipe of 10m length is 2 square metres, for example) whereas the thickness of the adhesive layers is typically very small (e.g. less than 0.3mm).

The invention has been illustrated by reference to a pipe in which the outer protective coating contains carbon black as the conducting agent. However, other conductive polymer mixtures could be used instead of carbon black-filled polyethylene. For example, the conductive agent could be a metal powder or metal fibres instead of carbon black. Alternatively, a conductive polymer could be used.

It will readily be apparent that numerous alterations and modifications could be made to the embodiment illustrated in the drawings without departing from the principles underlying the invention, and all such modifications and alterations are intended to be embraced by this application.

CLAIMS

1. A multilayer pipe for carrying hydrocarbon materials, the pipe comprising an inner structural layer formed from a plastics material; a metallic hydrocarbon-resistant barrier layer disposed outwardly of the structural layer, the barrier layer being less permeable to the passage therethrough of hydrocarbons than the structural layer; and a protective layer disposed outwardly of the barrier layer; characterised in that the outer surface of the pipe is formed from a conductive material.

2. A multilayer pipe according to claim 1 wherein the inner structural layer is formed from a polyolefin.

3. A multilayer pipe according to claim 2 wherein the polyolefin is polyethylene or polypropylene.

4. A multilayer pipe according to any one of the preceding claims wherein the metallic hydrocarbon-resistant barrier layer is an aluminium foil.

5. A multilayer pipe according to claim 4 wherein the aluminium foil is wrapped about the inner structural layer.

6. A multilayer pipe according to any one of the preceding claims wherein the metallic hydrocarbon-resistant barrier layer is adhesively bonded to the inner structural layer.

7. A multilayer pipe according to any one of the preceding claims wherein the metallic hydrocarbon-resistant barrier layer is adhesively bonded to the protective layer.

8. A multilayer pipe according to any one of the preceding claims

wherein the protective layer is coated on its outer surface with a conductive medium.

9. A multilayer pipe according to any one of claims 1 to 7 wherein the protective layer is formed from a plastics material containing a conductive agent, or is formed from a conductive polymer.

10. A multilayer pipe according to claim 9 wherein the protective layer is formed from a plastics material containing a conductive agent selected from metal fibres, metal powders and carbon black.

11. A multilayer pipe according to claim 10 wherein the protective layer is formed from a polyolefin containing carbon black as the conductive agent.

12. A multilayer pipe according to any one of the preceding claims wherein the protective layer has a resistance of 10^7 ohms or less.

13. A multilayer pipe according to claim 12 wherein the resistance is 10^5 ohms or less.

14. A multilayer pipe substantially as described herein with reference to the accompanying drawings Figures 1 and 2.

15. A method of making a multilayer pipe as defined in any one of the preceding claims, the method comprising extruding the inner structural layer, wrapping a metallic hydrocarbon-resistant barrier layer about the extruded inner structural layer and forming the protective layer by extrusion coating onto the barrier layer.

16. A method of making a multilayer pipe substantially as described herein with reference to the accompanying drawings.

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Claims searched: 1-16 **Date of search:** 14 July 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): F2P (PC13, PC27, PF14)

Int Cl (Ed.6): F16L 9/12, 9/147, 11/04, 11/06, 11/12, 11/127, 11/14

Other: Online WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	NONE	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.